BECOMING A NETWORK-CENTRIC MILITARY:

THE CASE FOR APPLYING BUSINESS PROCESS

REENGINEERING CONCEPTS

GRADUATE RESEARCH PROJECT

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Michael D. Haddock

Abstract

Network-Centric Warfare (NCW) is the concept that will transform the Department of Defense (DoD) from an Industrial Age fighting force to an Information Age one. The concept of NCW has its basis in Metcalfe's Law, which states that the power, or effectiveness, of a network is an exponential function of the number of nodes in the network. NCW attempts to exploit Metcalfe's Law by using Information Technology (IT) to enable fighting forces to function as network nodes, thereby capitalizing on the power of the network and realizing the goal of doing more with less.

This paper examines the current state of NCW within the DoD. It takes a historical look at the value of information in warfare and the pace of IT development related to the military. The concept of NCW as a Revolution in Military Affairs (RMA) is also discussed in order to put the significance of NCW into perspective. The role of doctrine is examined to reveal that at the Joint level a lot of emphasis is placed on the goal of becoming network-centric. The research concludes by addressing the concept of Business Process Reengineering (BPR) as a tool for effectively bringing about change.

The analysis reveals that NCW promises to live up to its expectations as an RMA and truly revolutionize the way the military thinks and fights. It also reveals the DoD is lacking in a thorough implementation plan. When looking for an appropriate framework for the DoD to use, the concept of BPR was considered and found to be a good fit. BPR is geared towards *radical*, *fundamental* changes, terms which can easily be applied to NCW. The analysis concludes with some specific recommendations for using BPR principles to facilitate the DoD's transformation towards NCW.

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I. Introduction

"To Implement Network-Centric Warfare (NCW) as the theory of war for
the information age and the organizing principle for national military
planning and joint concepts, capabilities, and systems." - One of the top
five goals of the Director, Force Transformation, as stated on the
Department of Defense Office of Force Transformation Website.

Background

A prominent topic of discussion in defense circles these days is Network-Centric

Warfare (NCW) and how it promises to revolutionize the way the American military

conducts its business and fights its wars. In fact, this concept is so hyped that it is often

referred to as the next revolution in military affairs or the next "big thing."

There is little doubt that change is a constant in the way the military operates.

Traditionally, the military has plodded along at a slow but steady pace during protracted

times of peace and reaped the benefits of fundamental and monumental change during

times of war. More often than not, these fundamental and monumental changes have

resulted in revolutions in military affairs. History provides many examples of

Revolutions in Military Affairs, or RMAs, that have been experienced by America's

armed forces. The use of railroads to transport soldiers during the Civil War is one such

example in that it dramatically changed the way we fight and began a general

acceleration in the pace of ground warfare that we are to some extent still experiencing

today. During World War I, the incorporation of the internal combustion engine into

trucks and tanks started an RMA whose full impact was finally realized in the late 1930s

and early 1940s as the German concept of Blitzkrieg reached maturity. The interwar years of the 1930s brought about an RMA in the form of aircraft carrier operations, which challenged the core competencies of the world's dominant navies and eventually brought about the demise of the mighty battleship. One of the most significant revolutions of the post-World War II era was the concurrent development of nuclear weapons and space launch capabilities - the resulting intercontinental ballistic missile, or ICBM, changed the balance of power for generations and fueled the Cold War. Now, the rapid incorporation of Information Technology (IT) into every aspect of warfighting, from developing the "big picture" battle plan to deploying individual troops in the field has all the potential of evolving into the next RMA.

Problem

The issue facing senior Department of Defense (DoD) leaders is how to become network centric – that is, what is in place in terms of policies, procedures, guidelines, and most importantly, doctrine, that indicates that the DoD is ready to jump on the network-centric bandwagon? Currently, senior leaders within the DoD are just now starting to grasp the network-centric concept and what implications it could have for the DoD. Also, who is in charge of NCW efforts for the DoD? There are two different offices who play a significant role in the DoD's quest to become a network-centric force – the Assistant Secretary of Defense for Command, Control, Communications, and Information (ASD C3I) and the Office of Force Transformation, which is headed by a 3-star admiral who reports directly to the Secretary of Defense.

The Office of Force Transformation is relevant because the concepts of DoD

Transformation and Network-Centric Warfare are tightly coupled. As outlined in the

2001 Quadrennial Defense Review, Transformation lies at the heart of future U.S.

defense strategy and is an effort to modernize the military in the context of today's

security environment and abandon the Cold War force structure (QDR, 2001). Network-

Centric Warfare's role in all of this is quite simply that it is seen as the primary enabler

for force transformation and lies at the heart of several tenets of Transformation.

One of the best sources of information for the current status of NCW is the 2001

DoD Network Centric Warfare Report to Congress. This comprehensive document

outlines the overall intent of NCW and provides each of the service's plans for

integrating the technologies required for becoming network centric. The contents of this

report highlight some interesting aspects of the DoD's approach to becoming network-

centric. First, although this is an overarching DoD program, each service has initiated

individual programs to implement NCW concepts. There is little intraservice

coordination between the military branches and each has different concepts of NCW

based on their unique service differences. Second, within each individual service, there is

a general lack of developing the concepts of NCW that leads to a proper comprehension

of what NCW is. What is lacking is a defined framework that the individual services and

the DoD as a whole can use to implement network centric concepts. The DoD may need

to implement a process that will help it focus on properly implementing NCW. One

possible framework for this process is a technique known as Business Process

Reengineering (BPR). BPR is a methodology for looking at the processes that occur

within an enterprise and looking for ways to redesign them in ways that will reap great

rewards in terms of efficiency or effectiveness. This purpose of this paper is to examine the concepts of NCW and BPR and then to determine if BPR provides a suitable framework to facilitate the DoD's implementation of NCW.

Research Question

This research paper seeks to answer the question: "Can the concepts of Business Process Reengineering be used to develop a framework for implementing the changes required to transform into a network-centric military?" Becoming more network-centric is a top priority of the DoD.

Investigative Questions

These questions will be addressed to answer the primary research question:

1. What is the potential impact of the network-centric warfare concept for the Department of Defense?

2. Does NCW currently meet the criteria for being a true revolution in military affairs?

3. What does doctrine say about the concept of network-centric warfare?

4. What is business process reengineering and what determines if a process is suitable for business process reengineering concepts?

Proposed Methodology

This paper will be completed in three phases. First, a qualitative analysis of documents will establish a working definition of Network-Centric Warfare and it's implications to the military. Second, the concept of Business Process Reengineering will

be defined to include impacts, scope, benefits, and implementation guidelines. Last, an

evaluation of Network Centric Warfare will be made using the concepts from the second

phase in order to determine if Business Process reengineering is an appropriate model for

developing the game plan to implement Network Centric Warfare.

Scope and Limitations

This paper will examine issues from the perspective of the DoD as a whole. It

will not look at the individual services except in an anecdotal manner to provide

examples. The results of this paper should be equally applicable across all parts of the

DoD.

II. Literature Review

Overview

In order to develop effective responses to the research questions posed in this paper, a comprehensive review of the existing literature is required. Since both Network-Centric Warfare (NCW) and Business Process Reengineering (BPR) are current topics of great interest to both the civilian and military communities, there is an abundance of related literature available on both printed media and the Internet. After delving into these research sources, the task at hand was no longer finding any relevant information, but instead to pour through the volumes and gigabytes of available material to pick out only that which could provide meaningful information. Although this paper deals directly with the topics of NCW and BPR, some related topics must be identified and researched in order to provide a complete framework. These topics include the concept of a Revolution in Military Affairs and the value/evolution of information and information technology in warfare. The tenets of Network-Centric Warfare form a hierarchy of their own and will be further broken down within that section. A review of military doctrine is also required, in that doctrine is an important vehicle for providing and implementation roadmap for the Department of Defense. The concept of Business Process Reengineering will be reviewed last. It exists as a stand alone topic for the purposes of this research paper.

The Value of Information and Information Technology in Warfare

Information has played a key role in warfare that can be traced all of the way back to the beginnings of recorded history. Battles have been won and lost on the value,

availability, and timeliness of information. One of the earliest such examples comes from the year 490 B.C. and the story of the battle of Marathon, fought between the Greeks and the Persians. A Persian army had landed on the plain of Marathon, which was about twenty-five miles from Athens, and was intent upon capturing and enslaving that city. Needless to say, much was at stake for the Athenians. In additions, as Athens was one of the more influential and powerful of the Greek city-states, a defeat at the hands of the Persians had the potential to destroy the entire system of Greek city-states and put an end to Greek civilization and culture. (Lovett, 1997)

When the Persians landed, an Athenian messenger named Philippines ran to the Greek city-state of Sparta to seek their assistance. Amazingly, Philippides covered the 150-mile trek on foot in less than 2 days - a feat of distance over time that would not be bested for centuries. Meanwhile, the Athenians decided not to wait for the Spartans, but instead launched a quick attack against the Persians before they had time to prepare. The Greeks ultimately prevailed against great odds. Upon their victory, another messenger was sent on the 26-mile trek to Athens to report the Greek victory. The runner completed his trek in only a couple of hours, relayed his message, and then died of exhaustion. The speed with which the two messengers relayed their different messages allowed the Athenians to react properly to the situation and helped preserve their status among the other city-states. The main point to be taken from this story, however, is that in the year 490 B.C., information, including critical military information, moved at an extremely slow pace, even under the best of circumstances. (Lovett, 1997)

Now fast-forward over 2,200 years to see what had changed, or more precisely, what hadn't changed, by the early 1800s. In his book *The Victorian Internet*, author Tom

Standage picks up the story in the beginning nineteenth century, where amazingly, little had changed regarding information technology. The value of information was just as important as it had always been, maybe even more so, and the face of warfare had also changed dramatically. This period in time saw large formations of troops and cavalry armed with muskets, pistols, and artillery and was the age of Napoleon, Wellington, and Clausewitz. This was also the time of the transition from militaries in the employ of the nobility to the militaries of the nation-states that defined the structures of the military and of warfare that are still in existence today. Yet despite all of this change, the amount of time it took for information to traverse from one place to another had changed very little from the year 490 B.C. because for the most part, no real advances n information technology had taken place. In the year 1800, sending information a distance of 100 miles still took the better part of a day. This set of circumstances "was as much a fact of life for George Washington as it was for King Henry VIII, Charlemagne, and Julius Caesar" (Standage, 1998).

It has been established that for thousands of years the flow of information was slow. When news was spread or when information was sent, it rippled outward from its source of origin and moved no faster than the person, horse, or ship that carried it. The first real breakthrough came in the mid-1800s with the invention of the telegraph, and it provided a tremendous increase in the speed of information flow. This technology was of course rapidly adopted by civilian and commercial interests, but it was also rapidly embraced by militaries that saw the value of being able to rapidly transmit and receive information to distant locations.

One of the earliest examples of the utility of this new technology comes from the Crimean War of 1854, which saw the forces of Imperial Russia pitted against those of Great Britain and France. The British troops deployed to the Crimean Peninsula also brought a telegraphic cable with them so that they could have instantaneous communications directly with London. This was the first time in history that a government had real-time, direct communications with commanders that were deployed to distant battlefields - the harbinger of centralized control/decentralized execution. This technology also came with its pitfalls, however, of which there are two such examples from this campaign. The first example regards the need to protect vital information regarding military troop movements and intentions. There was previously no danger in a newspaper such as the *Times* of London printing stories of British troop movements overseas because for the most part the actual arrival of the troops would have far outpaced the news of such. This was no longer the case as the technology of the telegraph allowed the current day's headlines to be sent to any location that had a telegraph. The second relates to the level of communication between headquarters and deployed forces. In this case, the British commander ended up cursing his telegraph because he could not concentrate on directing his forces due to the slew of trivial inquiries from his "incompetent" superiors in London. (Standage, 1998)

From this point on, the telegraph became as much a necessity of war as did guns and bullets. The telegraph was a widely-deployed tool during the American Civil War of 1861-1865. Both sides of this conflict strung up no less that 15,000 miles of telegraph wire and it immediately followed troop advances into Georgia, the Carolinas, and the western reaches of Texas. This situation was typical of most military engagements of the

last half of the nineteenth century to the point that accounting for telegraph supplies and operators became as much a part of military logistics as cooks and quartermasters had traditionally been.

The utility of the telegraph as a military tool continued up through World War I, when it began to be supplanted by other technologies, such as the telephone and the radio, which to some degree were just technological extensions of the telegraphic concept. At any rate, the era of the telegraph was the beginning of a general acceleration of information technology and need for information products that continues to this day.

As we examine the state of military affairs today at the dawn of the twenty-first century, it is readily apparent that the value of information in warfare has maintained its importance. Information has even added a new dimension to warfare and great emphasis has been placed on the ability to collect, disseminate, access, and utilize information and information-based products. Many innovations from recent conflicts have been based on information and information technology and a lot of the focus of military development has migrated in this direction from the more traditional hardware-based mindset. One example of this is the "Smart Tanker" concept, which has been fielded in a limited capacity by the Air Force. The "Smart Tanker" consists of a standard KC-135 tanker that also carries a robust, high-bandwidth communications package on a standard air cargo pallet. Since the standard air refueling concept of operations (CONOPS) calls for the tanker to remain in a relatively small, fixed orbit over or near a theater of operations for an extended period of time, it is in effect synonymous to an extremely low-flying satellite. Putting communications equipment on this tanker is an innovative way to provide the communications services comparable to those of a satellite over a geographic

area up to a few hundred miles in diameter. (Siciliano, 2002) In its so-far limited

fielding, the concept has proven itself of such utility that the Air Force is already looking

ahead to its next-generation tankers, ensuring that they have this capability as standard

equipment (Tirpak, 2003).

A continued discussion of these trends and advancements in the twentieth and

twenty-first centuries and their implications to the way we fight wars will follow in

subsequent sections of this paper. Highlights of this discussion include theories

regarding the transition of warfare from the Industrial Age to the Information Age and the

concept of Revolutions in Military Affairs and the impact they have on the nature of

warfare. There will then follow a section devoted to the currently developing RMA.

Revolutions in Military Affairs

Webster's dictionary defines a revolution as "a sudden or radical change in a

situation" and as "activities directed toward effecting basic changes" (Webster's, 1994).

From a more military-centric point of view, the Center for Strategic and International

Studies defines it as "a fundamental advance in technology, doctrine, and organization

that renders existing methods of conducting warfare obsolete" (Jablonsky, 1994). This

latter definition forms the basis of a definition for revolutions so profound to the military

that they change the fundamental way the military operates. These types of revolutions

are referred to as Revolutions in Military Affairs (RMAs).

Historical Revolutions in Military Affairs

In an article for the publication *The National Interest*, Andrew F. Krepenevich

surmises that there have been as many as ten major RMAs that have occurred since the

fourteenth century. Two of them came about as a result of the Hundred Years' War (1337-1453). The first is referred to as an infantry revolution where infantry replaced cavalry as the dominant force on the battlefield. The technology that enabled this RMA was the development of the longbow, which provided archers with a long-range weapon that allowed them to decimate knights on horseback from a distance that rendered them safe from the hand-to-hand weapons the knights carried. As an added benefit, archers were easier to train and cheaper to equip than standard cavalry soldiers.

The development of a more potent gunpowder recipe coupled with advances in cannon manufacturing enabled the second RMA from this period, the artillery revolution. Hints of this RMA began to surface in the tactic of city sieges. Before the change, campaigns to lay siege to a city usually resulted in a war of attrition. An attacker who could not penetrate a city's defenses usually had to just wait it out until the city ran out of supplies - which usually became a very protracted affair. Starting in the 1420s, however, the number of cities surrendering due to the defeat of defenses at the hands of artillery increased dramatically. This started a trend of richer states using these technologies to subdue their neighbors, thereby increasing the power gap. (Krepenevich, 1994)

RMAs have seemingly continued along this trend. Other such revolutions include the transformation of sailing ships from troop transports to artillery platforms in the seventeenth century and the development of new land warfare tactics and fortress designs after that.

The Industrial Revolution brought about a significant RMA that came to fruition during the time of Napoleon. The ability of mass production to allow the standardization of artillery and musket calibers, as well as other equipment, allowed the French to

significantly streamline their logistical processes in a way that most other nations would not be able to duplicate for years or decades. Manufacturing advances realized a 50 percent reduction in the weight of cannons, which increased mobility while decreasing requirements for transportation resources and manpower.

As mentioned before, the introduction of the telegraph changed the nature of warfare based on the availability of up-to-date information. When coupled with the contemporary expansion of the railroads it ushered in another RMA characterized by rapid movements of large numbers of troops to important points of decision. One spectacular example of the utility of these new technologies comes from the American Civil War when the Union Army shifted 25,000 troops, along with associated artillery, baggage, and supplies, over 1,100 miles of rail line from Virginia to Tennessee in less than 12 days. It was an example of mass over distance over time that had not been seen before and highlights the potential effects of both taking advantage of new technologies and the synergistic effects of combining those technologies. The telegraph provided the information as to where the troops were needed, but the value of that information would have been much less without a viable transportation mechanism. Likewise, the railroads provided fast transportation, but without the information provided by the telegraph, the strategic decision of where to send troops may have been little more than guesswork. (Cohen, 1996)

There were several RMAs that came about during the twentieth century, a phenomenon that many believe signals a general acceleration in the pace of technology and the advent of RMAs. The internal combustion engine brought about an RMA during World War I, embodied in the airplane, tank, and utility truck. Advances in technology

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and tactics in the interwar years brought about the RMAs of carrier warfare, blitzkrieg, amphibious assault, and strategic bombardment. World War II quickly became a proving ground for these advances in technology.

The next big RMA following World War II was that of the nuclear revolution. When coupled with the development of the ballistic missile, this RMA brought about the dynamics that resulted in the Cold War which dominated the last half of the twentieth century.

Since the end of the Cold War, there has been a growing body of evidence suggesting that we are currently undergoing another revolution based on information and information technology. Since that revolution is the main focus of this paper, it will be discussed more fully in subsequent sections.

Defining Revolutions in Military Affairs

In his book *Past Revolutions, Future Transformations*, Richard O. Hundley provides another view that an RMA is based on its defining characteristics:

An RMA involves a *paradigm shift* in the nature and conduct of military operation

- Which either *renders obsolete* or *irrelevant* one or more *core competencies* of a dominant player,

- Or creates one or more new core competencies, in some new dimension of warfare,

- Or both. (Hundley, 1999)

Hundley also goes on to identify other notable characteristics of RMAs. While all of these characteristics don't have to be present to categorize a development as a true

RMA, they are useful as evaluation criteria and will be incorporated into this paper later in the methodology section. These characteristics are as follows:

- *RMAs are rarely brought about by dominant players.* Examples of this include the development of blitzkrieg concepts in the 1930s by the non-dominant Germans and how the dominant British Navy did not develop carrier warfare principles.

- *RMAs frequently bestow an enormous and immediate military advantage on the first nation to exploit them in combat.* Again, the German blitzkrieg exemplifies this as does the initial use of the machine gun during World War I.

- *RMAs are often adopted and exploited first by someone other then the nation inventing the new technology.* The American machine gun was first employed on a revolutionary scale by the Europeans and even though the British were the inventors of the tank, it was exploited by the Germans.

- *RMAs are not always technology driven.* Napoleon's three-pronged attack tactics and troop formation advances during the American Revolutionary War were revolutionary in nature, but did not rely on the development of any new technologies.

- *Technology-driven RMAs are usually brought about by combinations of technologies, rather than individual technologies.* An example of this is the ICBM, which could only result from the fusion of ballistic missile, nuclear warhead, and inertial guidance technologies.

- *Not all technology-driven RMAs involve weapons.* The railroads and telegraphs of the mid-1800s were definitely not weapons in and of themselves, but they

were the enabling technologies for the information and transportation RMAs of
that period.

- *All successful technology-driven RMAs appear to have three components:*
  technology, doctrine, and organization. This characteristic applies more to
  modern RMAs than it does to historical ones. While technology has been well-
  documented throughout history, there is much less noted regarding organization
  and very little regarding doctrine. This has changed in the modern era, with
  well-documented components of each for the RMAs of blitzkrieg, carrier
  warfare, and ICBM employment. In his Naval War College paper, Lieutenant
  Commander Timothy W. Quinn calls the relationship between these
  components the "RMA Trinity" and suggests they exist within a strategic
  context that defines what an RMA is. Figure 1 is a graphical representation of
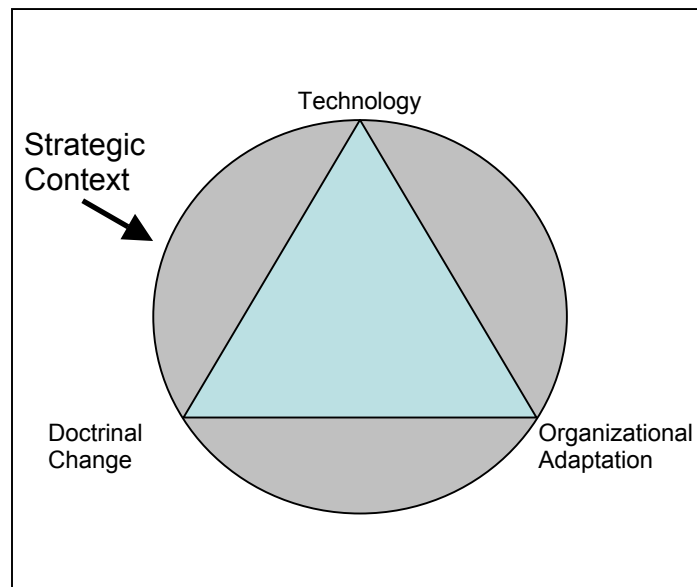 the "RMA Trinity"

Figure 1 - Pictorial Representation of the "RMA Trinity" (Quinn, 1999).

- *There are probably as many failed RMAs as successful ones.* This is more of an observation than a characteristic as it would be hard to apply this to RMAs that have come to fruition. However, Hundley does list a few examples of technologies that had the potential to become RMAs but as of yet have not yet realized their potential. These include nuclear-powered aircraft and the electromagnetic gun.

- *RMAs often take a long time to come to fruition.* Early RMA's, like the use of the longbow, developed slowly and could take several years, even as much as one hundred, to go from concept to fruition. The pace of this development does seem to be closely related to the pace of technology, and as that pace accelerates, so does the pace of RMA implementation. Carrier warfare and the blitzkrieg concept came about in a couple of decades and ICBMs came about in just over one decade. The current RMA, if it is a true RMA, could be realized in just a little over a decade.

- *The military utility of an RMA is frequently controversial and in doubt until it is proven in battle.* Carrier warfare was in doubt until the battle of Midway in 1942. There was also much debate in the transport of troops by train in the nineteenth century and although it was never really proven in battle, the deterrent force of ICBMs became apparent when they were thrust to the fore front of the Cuban Missile Crisis in 1962. (Hundley, 1999)

There are some camps that wonder why so much study should be devoted to the topic of identifying RMAs. To them, RMAs will happen whether we identify them or

not. In fact, the term RMA has only come about within the last 30 years and has been

retroactively applied to events prior to that time. It is argued that these RMAs occurred

even without great effort to understand or characterize them and that a similar attitude

could be adopted for the current RMA - it will happen whether we examine it or not.

An article in the Spring 1994 issue of *Joint Forces Quarterly* counters that

opinion and contends "there is a substantial cost for failure to recognize revolutionary

changes in warfare" (FitzSimonds & Van Tol, 1994). It goes on to state that RMAs

matter for two principle reasons. First, being the second-best (or lower) military power

carries the potential for catastrophic loss in future conflicts. Combat success is usually

the primary objective benchmark for measuring military effectiveness, but such

opportunities might not exist in periods of extended peacetime or in the new environment

of asymmetric and small-scale contingency warfare that the U.S. has found itself

increasingly involved in during the last decade. A different type of metric is required for

these conditions and evaluating the U.S. military against emerging or existing RMAs can

serve as that metric. Its biggest advantage is that it will avoid the substantial cost of not

properly recognizing and taking advantage of revolutionary changes before an adversary

does. (FitzSimonds & Van Tol, 1994)

The second principle reason has to do with the phenomenon of ever-increasing

equipment life cycles. This is exemplified in the fact that the U.S. military is still flying

planes designed and built in the 1950's and most Navy ships are based on 40-year old

technology. This can be projected to surmise that in another 30 or 40 years, we will still

be using equipment being designed and built today. It is therefore crucial to examine

now the possible effects of future RMA in order to project force structure accordingly.

The next section of this paper begins to look into these effects by discussing the possibility that we are now in the middle of another developing RMA. (FitzSimonds & Van Tol, 1994)

The Current Revolution in Military Affairs

As has been stated previously, there is a growing body of evidence that the U.S. military is currently experiencing another RMA. This revolution is also technology-based in nature, but instead of exploiting technological advances in weaponry, this RMA is based on information and information technology. While this RMA has much in common with past revolutions, there is also much that is different.

The initial indication that there is a developing RMA is, surprisingly, of Soviet origin. Its beginnings were in a hypothesis proposed by Nikolai Ogarkov, a Marshal of the Soviet Union. He surmised the generation of precision-guided weapons that were at the time emerging, when coupled with improved sensors and developing information technologies, created a new synergy that would change the dynamics of warfare in a revolutionary manner. (Owens, 1998)

The Soviet Union has since fallen since Marshal Ogarkov's theories emerged, but the cause has been taken up by the U.S. defense establishment. It received a big boost after the conclusion of the 1991 Gulf War, as analysts began to assimilate the data regarding the results of better integration of newly-fielded sensor systems and precision-guided munitions, which used the Gulf War as a proving ground. Many exponents now declared that "technology had finally caught up with the promise of air operations" (Cohen, 1996). Indeed, examples abound of the new technology-based weapons and

their associated acronyms that made their debut during this conflict: GPS, JSTARS, TLAM, and CALCM, just to name a few. It is now spoken of in terms of its role in an all-encompassing concept called Force Transformation (which will be addressed in a subsequent section).

Network-Centric Warfare (NCW)

Origins of the NCW Concept

Although they did not invent the term, Vice Admiral Arthur K. Cebrowski and Mr. John J. Gartska wrote a landmark 1998 article on the current RMA which helped to popularize the name by which it is now commonly referred: Network-Centric Warfare, or NCW. The article, titled "Network-Centric Warfare, Its Origin and Future," attempted to define the future of U.S. military operations as dependent upon, and capitalizing from, advances in information technology. This quote from the article emphasizes the importance the authors placed on NCW:

> "We are in the midst of a revolution in military affairs (RMA) unlike any seen since the Napoleonic Age, when France transformed warfare with the concept of levee en masse. Chief of Naval Operations Admiral Jay Johnson has called it "a fundamental shift from what we call platform-centric warfare to something we call network-centric warfare," and it will prove to be the most important RMA in the past 200 years." (Cebrowski and Gartska, 1998)

Cebrowski and Gartska contend that the concept of NCW, although pertaining to the military, has its roots in fundamental changes impacting American Society. It is a paradigm shift of sorts, and contends that the dynamics of military/civilian reliance open one another in regards to technology development have undergone a role reversal. This role reversal is best summed up in the book *The Changing Role of Information in Warfare*, edited by Zalmay M. Khalilzad and John P. White:

"The Department of Defense (DoD) has little control over the pace and direction of the information revolution. Although in the past DoD played an important role in developing, refining, and implementing new information technologies, today the technological envelope is being pushed largely by the commercial sector. DoD needs to manage a difficult transition from being a pioneer to being a leading user. This transition will require not only keeping abreast of new technological developments but also accepting that technology will no longer be developed exactly to military specifications." (Khalilzad and White, eds., 1999)

What this implies is profound and is quite the departure from the traditional way of military thinking. Instead of the military being the master of its own destiny, it must now submit to the greater influence of society as a whole and adapt to the changes taking place there. Where it was once a technological leader, it is now a follower. Cebrowski and Gartska refer to overwhelming changes in the business sector as the impetus for this. They contend that the power of the network is undeniable. Citing Metcalfe's Law, which states that the "power" of a network is proportional to the number of nodes in the network, the "power" or "payoff" of network-centric computing comes from information-intensive interactions between very large numbers of heterogeneous computational nodes in the network (Cebrowski and Gartska, 1998). Figure 2 is a representation of Metcalfe's Law which demonstrates the relationship between the number of nodes in a network and its computational effectiveness:

Non-linear relationship:
power is proportional to N^2

Linear relationship: power is proportional to n

POWER

1 2 3 4 5 6 7 8 9 10
NODES

Each node in a network of "N" nodes is capable of initiating "N-1" interactions

Total number of potential interactions between nodes in the network
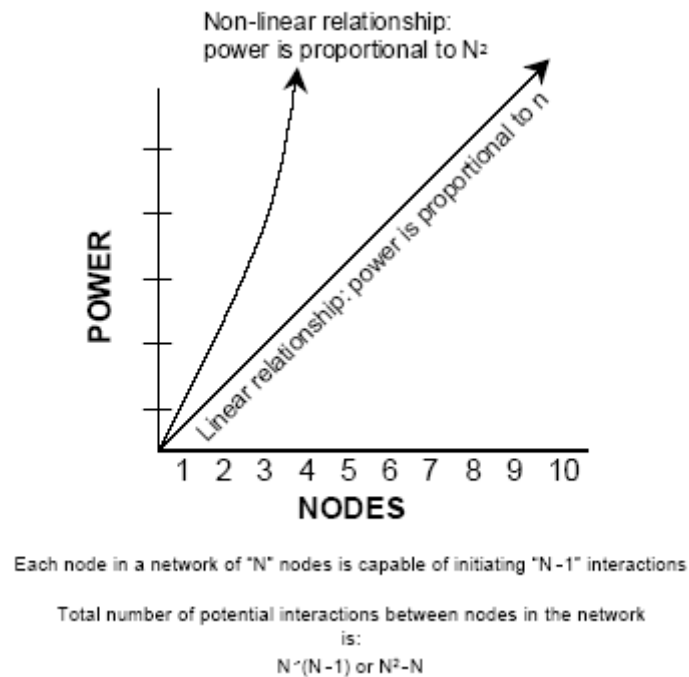is:
$N*(N-1)$ or N^2-N

Figure 2 - Relationship Between Network Nodes and Network Power According to Metcalfe's Law (Alberts et al., 1999).

Cebrowski and Gartska go on to state that the business sector has already recognized the potential benefits of network-centricity and has realized competitive advantages of it. They state that the building of high-quality networks is now a top priority for businesses, as is shifting views from that of being an independent entity among partners to that of existing as a part of a larger ecosystem of business that is connected by a closely-coupled transaction grid. (Cebrowski and Gartska, 1998)

The last point made by Cebrowski and Gartska is that the U.S. military has as much to gain from network-centric operations as the business sector does. The general increase in responsiveness by businesses that adopt network-centric strategies and their ability to deal better with change are plusses that can also be reaped by the military on the battlefield, where speed, adaptability, and responsiveness are everything. Making the

transition from theory to practice, the next section takes a more detailed look at exactly where the U.S. military stands today in terms of adopting and implementing NCW principles.

Specifics of NCW

Now that it has been established how NCW came to be identified, the focus will turn to the more detailed discussion of just exactly what NCW is. As stated earlier, NCW is the term used in military circles to define information-based warfighting. Under the NCW concept, all aspects of the battlefield are connected via a network in real time. This network consists of nodes ranging from remote headquarter and command and control entities to individual soldiers on the battlefield and everything in between. When taking this into context with the principles of Metcalfe's Law from the previous section, NCW can provide order-of magnitude improvements in the situational awareness of all network nodes and can facilitate the ability to bring commander's intent and overwhelming mass to the enemy at precise points. It also promises to do this with a much leaner logistics tail. (Oracle, 2003)

NCW warfare is conducted in a battlespace. This battlespace is a three-dimensional perspective of the traditional battlefield. Also, there is a part of this battlefield that consists of the networked portion. When NCW is fully realized, this networked portion will be referred to as the global information grid, or GIG. The GIG will essentially be a globally-aware infrastructure that will always be available to the user and should for the most part be transparent. The GIG will provide accurate, timely, and relevant data that will facilitate a common operational picture. Sensors, platforms and operators (military forces) are all connected to share information. Forward-deployed

forces can use "reachback" to get information from intelligence databases located in the United States or from some other area not necessarily adjacent to the battlefield. NCW will also allow different types of forces, such as air, ground and sea forces, to self-synchronize. Self-synchronization is a technique to be readily adaptable and innovative to allow the rapid addressing of emerging combat situations. It is akin to ad-hoc planning on a joint scale. It allows each type of force to quickly and seamlessly assimilate itself into a combined package with other forces for maximum combat effectiveness.

It is important to note that NCW does not eliminate the decision-making authority of the front-line combatants, nor does it step on the toes of the tenet of centralized control/decentralized execution. What its potential really lies in is its capability to enhance the ability of the individual combat units (or network nodes) to see the big picture, draw on available resources, and reduce the Clausewitzian "fog of war".

Comparable to the impact it is having in the business world, the effects of information technology on twenty-first century warfighting are revolutionary and far reaching. The current issues facing the military are how to best use information technology, how should the military's twenty-first century information technology infrastructure be built, and how will forces organize to make the most use of information technology while preserving the traditional "boots on the ground" advantages of forward persistence and presence. (Oracle, 2003)

One of the principles of incorporating NCW is realizing a shift from the present way of conducting military operations to the new network-centric environment. The term platform-centric warfare, or PCW, has been coined to describe the current environment. Under PCW, systems are not interoperable between different types of equipment, or

platforms, and the battlespace picture presented to the warfighter is only a subset of the complete picture, from the point of view of the specific platform. As an example, F-15s within the same operating area have the ability to electronically communicate with one another and share critical targeting and threat information. Therefore, the operators of these platforms have a battlespace picture, but only from the context of the F-15. These F-15s aren't sharing the data with the B-52s which are operating in the same area but within their own battlespace picture. Most certainly, there is no interaction with the C-17s and C-130s operating in close proximity or with the Navy assets just offshore.

NCW promises to change all of this by integrating all information into a single, comprehensive, and real-time picture of the battlespace, previously identified as the GIG The GIG is a "one-stop shop", if you will, of all the information and services available that have been centralized and made available to all those who need it. Continuous advances in information technology are rapidly approaching the point where implementation of the GIG will be a reality.

In summary, NCW is a shift from platform-centric operations to network-centric operations. It is a concept in which the full spectrum of information in relation to the battlespace has been collected real-time into a single information source and where it can easily and readily be disseminated to those who need it. The possibilities that this can open up are endless. To summarize, here are the basic tenets of NCW:

1. A robustly networked force improves information sharing.

2. Information sharing and collaboration enhance the quality of information and shared informational awareness

3. Shared situational awareness enables self-synchronization

4. These, in turn, dramatically increase mission effectiveness. (NCW Tenets, 2004)

Although it is important to understand all of the concepts of NCW for the purpose of this paper, it is fitting at this point to end this section with a single quote that puts the whole NWC issue into perspective: "Networked forces outfight non-networked forces" (Cebrowski, 2003). That is the whole premise behind NCW.

Network-Centric Warfare Report to Congress

Findings of the Report

In fiscal year 2001, the Defense Authorization Act contained a section that called for the Secretary of Defense, in conjunction with the Joint Chiefs of Staff, to develop a report related to NCW and the DoD's perspective on the current status of NCW and where it is going. In July 2001 the DoD submitted its report, titled *Network Centric Warfare; Department of Defense Report to Congress*. For the rest of this research paper, it will be referred to as the NCW Report to Congress. The report is several hundred pages long and provides a thorough explanation of NCW concepts, details of relevant DoD activities, progress within the DoD in developing NCW systems, and a brief description of the envisioned way ahead. This remainder of this section provides a brief summary of that report.

The NCW Report to Congress identifies NCW as "no less than the embodiment of an Information Age transformation of the DoD" (NCW Report to Congress, 2001). It talks about a completely new way of thinking towards military mission accomplishment and how the U.S. military must changes its ways of organizing, training, equipping, and fighting in order to adapt to the new paradigm. The report states that some of the

technologies and techniques that will come about as a result of implementing NCW have yet to be conceived and the whole process of transformation could span the timeframe of a quarter century or more. NCW warfare is also seen as the facilitator to realize the level of joint military operations as envisioned in *Joint Vision 2020*, which is detailed in the section of this paper covering the role of doctrine.

One thing that is stressed is that NCW does not yet exist as a developed and deployable warfighting capability. Instead, it is still in conceptual form but is supported by a growing body of evidence from many papers, periodicals, experiments, exercises, simulations, reports, and analyses. It is also stressed that a lot still needs to be done in order to move the military from the platform-centric force it is today to a network-centric one. (NCW Report to Congress, 2001)

The report discusses the basics of NCW, including what it is and its history as it applies to the U.S. military. These topics won't be covered here as they have already been covered in previous sections of this paper.

The concept of NCW is intended to be implemented DoD-wide and the report tries to put all of the concepts and discussions in terms of the DoD as an enterprise. Also included are the NCW concepts and visions of each of the individual services as is an overall DoD NCW implementation strategy.

The conclusion of the report presents several findings regarding the current and future ability to understand and implement the principle of NCW. These findings are worth repeating in this section to show the issues that are perceived in efforts to transform the military to a network-centric organization:

1. In the future, the network will be the single most important contributor to combat power.

2. There is considerable and growing urgency associated with removing any impediments to progress.

3. Timely removal (or mitigation) of the impediments to progress will be greatly facilitated by and OSD-level Office of Transformation to develop, and then help implement, a "transformation" of DoD business practices to enable a network-centric transformation of the DoD.

4. A goal to achieve a specific network-centric capability by a specific date is needed.

5. NCW offers unprecedented promise to achieve long-sought-after capabilities without corresponding increases in resources in the long run.

6. NCW should be the cornerstone of the Department's strategic plan for the transformation of the forces. (NCW Report to Congress, 2001)

Analysis of the Report

The NCW Report to Congress is significant in that it is the first DoD-wide effort to analyze the phenomenon of NCW and its impact on the military. In essence, the report agrees with the vast majority of the body of literature and knowledge existing prior to the report that contends that NCW is an almost inevitable force. Citing the general economic and global conditions of the Information Age, the DoD has accepted the fact that it must adapt in order to meet the changing conditions of the environment or it will be left behind and find itself vulnerable to being in the position of not being able to accomplish its mission.

One issue that came to light from the contents of this report concerns the current status of both understanding and implementing NCW across the DoD. The report goes into great detail to describe what NCW and the advantages it can provide to the military. Several examples of initial attempts to categorize NCW are cited, along with in-depth discussions of the potential benefits of NCW. It discusses the status of NCW in a context very similar to the "RMA Trinity" introduced earlier in this paper and discusses the status of doctrine, enabling technologies, and the methods of organizational adaptation. The doctrine that currently exists focuses on identifying the need to become network-centric and how NCW will become a cornerstone of the future warfighting environment. Technology is in the right place at the current time to facilitate the development of network-centric systems. Organizational adaptation is still in its infant stages and will require a lot more development.

More telling still was the section of the report that highlighted the NCW vision of each of the service branches. One issue that was noted was that each of the services have different concepts of what NCW warfare is and how it will help them be more effective. Even though there is currently a DoD-level concept of NCW, it is not yet robust enough to force the services to bust out of their stovepipes and focus development and implementation efforts towards a single well-defined network-centric goal.

NCW and Doctrine

The Importance of Doctrine

Doctrine (Definition) - Fundamental principles by which the military forces or elements thereof guide their actions in support of national objectives. It is authoritative but requires judgment in application.
                                                                Joint Publication 1-02

"At the very heart of war lies doctrine. It represents the central beliefs for waging war in order to achieve victory....It is the building material for strategy. It is fundamental to sound judgment."

General Curtis E. LeMay, USAF

"Doctrine provides a military organization with a common philosophy, a common language, a common purpose, and a unity of effort."

General George H. Decker, USA

"Doctrine [is] every action that contributes to unity of purpose... it is what warriors believe in and act on."

Captain Wayne P. Hughes, Jr., USN Fleet Tactics

- Taken From the Joint Doctrine Encyclopedia, 1997

In its most basic form, doctrine exists as guidance. It exists in many forms for many different entities and organizations. There is political doctrine, economic doctrine, social doctrine, educational doctrine, religious doctrine, and of course military doctrine. Doctrine has always been an essential part of the military existence. As noted in the first quote of this section, military doctrine, which from this point on will just be referred to as doctrine, is authoritative in nature, which means that is defines the standards by which the military is expected to act, but requires judgment in application, which means that it is not necessarily directive - those who employ doctrine have some leeway in its application based upon circumstances.

According to *Joint Publication 1, Joint Warfare of the Armed Forces of the United States*, military doctrine presents the fundamental principles that guide the employment of forces. Doctrine is largely based on experience and as such attempts to capture many of the "best practices" learned in the past regarding the use of the military in the grand scheme of national security. In its role as guidance, however, its does not

replace the ability of a commander to determine and follow the proper course of action based on the individual circumstances of each situation. (Joint Publication 1, 2000)

Military doctrine exists at many different levels. Each service develops its own specific doctrine, based on its individual missions and competencies. In some cases, different organizations within each service may develop their individual doctrine. For example, within the Air Force each major command develops its own doctrine for guidance. Air Combat Command has doctrine uniquely tailored for the missions it performs (air supremacy, close air support, strategic bombing). Air Mobility Command has doctrine tailored around aerial refueling, tactical and strategic airlift, and rapid global mobility. Air Force Special Operation Command's doctrine is developed around the unique circumstances of conducting small-scale special operations-type activities. When an organization develops doctrine, it must defer to doctrine of the next-highest level. For example, Air Mobility Command Doctrine may say anything it wants, but it may not conflict with Air Force doctrine.

The highest level of U.S. military doctrine is Joint doctrine, and it provides an overarching umbrella for how all of the individual services are to conduct operations together. Its goal is to provide the guidance to facilitate seamless integrated operations in an increasingly Joint environment. As noted before, service doctrine may not contradict Joint doctrine, so it attempts to strike the balance of providing a level of direction that is not so authoritative that it overly constrains the services while still guiding them to operate together.

The topic of NCW is not unique to any of the individual services. Indeed, it is truly a Joint concept and can only be fully realized at the Joint level. Therefore, the Joint

level has taken the lead in developing doctrine pertaining to NCW. The remainder of this section will now take a look at some of the Joint documents that address the importance of NCW warfare to the U.S. military in the context of the emerging picture of what the future of warfare holds for the U.S. military and how the military needs to change and adapt to this future.

Joint Vision 2010

In his article titled *Joint Vision 2010: The Concept of Future Warfighting for the US Armed Forces and its Relevance to the SAF*, Lieutenant Tay Gek Peng of the Singapore Armed Forces provides an excellent synopsis of the genesis of the Joint Vision documents. In 1995, the U.S. Commission on Roles and Missions of the Armed Forces issued a report regarding operations of the military during Operations DESERT SHIELD and DESERT STORM. The conclusions reached by the Commission were telling. The report praised the capabilities and level of performance of each of the four Services individually (Army, Navy, Air Force, and Marine Corps) and reaffirmed that they were each second-to-none in their respective areas of expertise. However, the report went on to say that there were significant interoperability issues and that the Services did not function very well together as an integrated joint fighting force. The Commission attributed this state of affairs to the lack of a common, unified vision that would guide each of the services to organize, train, equip, and execute in a joint environment. In order to rectify this situation, the Commission recommended that the Chairman of the Joint Chiefs of Staff (CJCS) develop "a future joint warfighting vision to help guide Service force development efforts." (Peng, 1999, 1)

The CJCS at the time, General John M. Shalikashvili, took to task the

Commission's recommendation and initiated efforts to develop a unified vision to guide

future joint operations (including both warfighting and non-warfighting operations). The

initial results of these efforts were realized in July of 1996 with the release of Joint

Vision 2010 (JV 2010), a 35-page primer on joint warfighting concepts. JV 2010 opens

with this quote from General Shalikashvili:

> "The nature of modern warfare demands that we fight as a joint team. This
> was important yesterday, it is essential today, and it will be even more
> imperative tomorrow. Joint Vision 2010 provides an operationally based
> template for the evolution of the Armed Forces for a challenging and
> uncertain future. It must become a benchmark for Service and Unified
> Command visions." (JV 2010, 1996)

The introduction from JV 2010 goes on to further define the goals of the

document:

> "Joint Vision 2010 is the conceptual template for how America's Armed
> Forces will channel the vitality and innovation of our people and leverage
> technological opportunities to achieve new levels of effectiveness in joint
> warfighting. Focused on achieving dominance across the range of military
> operations through the application of new operational concepts, this
> template provides a common direction for our Services in developing their
> unique capabilities within a joint framework of doctrine and programs as
> they prepare to meet an uncertain and challenging future." (JV 2010,
> 1996)

There are two key enablers identified in JV 2010 that lead to the development of

four new operational concepts for joint warfighting. Together, these four concepts

converge into a single primary goal. JV 2010 progresses to define each of these aspects

in order, however, for the purpose of this paper the flow will be reversed to start with the

primary goal and work backwards to the key enablers. This is necessary to highlight the

importance of the key enablers as the foundations of JV 2010. In particular, one of the

key enablers, which will be identified later in this section, is directly related to the primary focus of this paper.

JV 2010 defines its primary goal to be the evolvement of the individual services into a joint force driven towards a common goal: the development of a joint force that is persuasive (deterrent) in peace, decisive in war, and preeminent in any form of conflict. The last two parts of this goal, decisiveness and preeminence, are embodied in the concept of Full Spectrum Dominance. Under the concept of Full Spectrum Dominance, America would not seek to meet an opponent with a like force but would instead strive to posses the capability to dominate that opponent across the full range of military operations.

There are four operational concepts that make Full Spectrum Dominance a reality: dominant maneuver, precision engagement, full dimensional protection, and focused logistics. Dominant maneuver refers to more than just the physical domain. Its objective is the rapid positioning and employment of widely-dispersed joint forces and relies on the application of information, engagement, and mobility capabilities. Through sustained and synchronized operations, dominant maneuver allows forces and advantage by controlling the depth, breadth, and height of the battlespace. Precision engagement takes advantage of the so-called "system of systems" - individual systems that are integrated to the point that they provide seamless operation as if they were a single system. Precision engagement allows the joint forces to track and locate targets from extended ranges, generate the desired effect against those targets, and assess the level of success in order to determine if re-engagement is necessary. Precision engagement builds on current capabilities such as weapon delivery accuracy via precision guidance systems and low-

observable technologies. Full-dimensional protection allows for the unimpeded, effective employment of our forces while denying opportunities to the enemy. The primary method for providing full-dimensional protection is by controlling the battlespace, which in turn provides an adequate measure of protection for our forces. Focused logistics is relied on by each of the three preceding concepts to provide an optimized response. It is the result of the fusion of improvements in information, logistics, and transportation technologies. Focused logistics is intended to be highly responsive and flexible in order to facilitate the use of smaller, more capable forces. (JV 2010, 1996)

To bring together the goal of Full Spectrum Dominance with the four operational concepts that realize it, JV 2010 identifies two underlying "key enablers". The first is technological innovation. For the purpose of this paper, not much will be said about technological innovation except that exploiting technology and staying on top of the technology curve are essential requirements for maintaining dominance. Technological innovation has long been and will continue to be an essential warfighting tool.

The second "key enabler" identified in JV 2010 has also been around for a very long time and for just as long has been a determining factor to the outcome of military operations. This enabler is called Information Superiority and its importance as a tool has risen greatly in the twenty-first century warfighting environment. Information superiority is defined as "the capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same" (JV2010, , 1996). Information superiority, and information technology in general, is the tie that binds all of the other concepts of JV 2010 together and allows the envisioned joint fighting force of the U.S. to become a reality.

There are many aspects to the concept of information superiority. On the technological side, information superiority means an increased level of access to information products with an unparalleled speed and accuracy. Interoperability, automation, and autonomy are all exploited through technological advances and facilitate the old maxim of "doing more with less." Two other aspects of information superiority are more directly linked to the battlefield in both the physical and virtual sense. Offensive Information Warfare is directed at degrading or exploiting the information capabilities of an adversary. This includes the traditional methods such as a physical attack to degrade or destroy a system of facility as well as emerging methods such as electronic intrusion in order to deny, spy upon, or deceive an adversary's forces and decision makers. Defensive Information Warfare can be simply stated as measures taken to protect friendly forces and systems from an adversary's attempts to employ offensive information operations of their own. Some of the more common defensive information warfare activities include securing physical access to equipment, network defense, data encryption, anti-virus protection, and defense from so-called "hackers" who attempt to gain access to systems through security weaknesses in order to cause damage or exploit information. One of the more interesting aspects of information warfare activities in general is that they may increasingly involve the use of non-military actors who can make their attacks from almost anywhere. This allows them to wage war at extreme proximities from traditional battlefields. (JV 2010:16)

In summary, JV 2010 is significant in that it defines the future role and construct of the American military and signals a revolutionary departure from past practices and methods. Also significant is the emphasis placed in information technology as one of the

tools and one of the key enablers required to bring these changes about and to stay effective as a fighting force. The following figure was taken from JV 2010 and demonstrates in a pictorial manner how Information Superiority forms a ring around the operational concepts that allow the desired state of Full Spectrum Dominance.
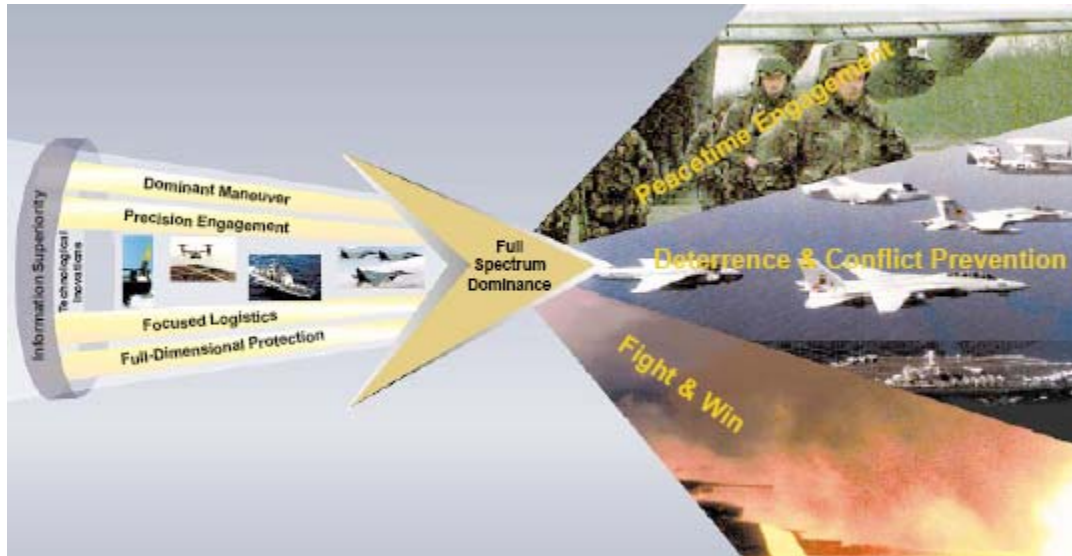

Figure 3 Pictorial Representation of the Concepts Identified in *Joint Vision 2010*.

Joint Vision 2020

When Joint Vision 2010 was written in 1996, it was an attempt to focus the U.S. military in a post-Cold War direction, although the exact environment in which it was to operate was still largely undefined. Many lessons and examples were extracted from the Gulf War, but it was unclear if this conflict was to serve as a template for future U.S. challenges. By the year 2000, several events had occurred that provided more insight into what the future was to look like. Lessons from Somalia and Haiti were incorporated, as was the analysis of military operations that had occurred in the Balkans, namely the operations in Bosnia and Kosovo. Accordingly, the Department of Defense wanted to

capture all of this into doctrine, so in June of 2000, it released a 36-page document called Joint Vision 2020 (JV 2020). JV 2020 is not a replacement for Joint Vision 2010, instead, it builds upon the concepts introduced in Joint Vision 2010 and frames them in the context of the evolving global situation (military, political, economic, and social).

JV 2020 starts off by defining the new "strategic context" of the global environment. There is an emphasis that the U.S. will still have global interests and accordingly will still have to interface with a variety of actors including independent, national, and trans-national entities. The technology revolution will still be rolling along and exponential advances in transportation, communications, and information technology will facilitate international interaction. Also, preserving American interests in economic, social, and political arenas will force the U.S. to strengthen and maintain a front and center presence on the world stage. JV 2020 highlights that although it is not the only tool for doing so, the U.S. military is often times the organization tasked to be the instrument of U.S. policy overseas. JV 2020 also briefly touches on the subject of terrorism and non-state actors, but it was written before the bombing of the USS Cole and the terrorist attacks of 11 September 2001. (JV 2020:4)

JV 2020 expands beyond the concepts of joint operations and places much more emphasis on placing the U.S. military as a part of a bigger puzzle. One level is defined as structuring the military as a seamless joint organization that must integrate with other non-military U.S. organizations. Specific examples include law enforcement and federal disaster relief agencies. Taking it one step further, JV 2020 then emphasizes the role of the U.S. as a member of the international community where our forces will also be required to interoperate on a multinational level.

Under the JV 2020 assessment, more emphasis is placed on the premise that the nature of warfare is changing. While it doesn't rule out the possibility of traditional full-scale force on force warfare, it stresses that there is increased likelihood for more isolated, regional conflicts and heavy involvement in military operations other than war and that the U.S. military must be fully prepared to engage in any type of these scenarios at any time. (JV 2020:12-13)

Like the document preceding it, JV 2020 again states that one of the key enablers for all of the concepts identified within it is the premise of information superiority. The concepts of interagency and multinational interoperability are just as dependent upon information systems as previous concepts have been. Information operations are identified as one of the most effective warfighting tools against non-state actors engaging the U.S. in nontraditional conflict. The value of information operations in military operations other than war, such as humanitarian relief operations will also increase as we are more reliant on information systems to facilitate military capabilities. Most significant of all, JV 2020 sates that "operations within the information domain will become as important as those conducted in the domains of sea, land, air, and space (JV 2020:30)". This further strengthens the premise that the role of information and information operations is taking a prominent role in the future of the U.S. military.

Military Transformation Guidance

Although we have just seen in the discussion of the *Joint Vision* documents that the concepts regarding the importance of information superiority and network-centric operations are very much at the heart of future defense strategy, the overall Joint Vision goal encompasses a little bit more and is embodied in the overarching concept of

Transformation. Transformation is about changing the culture of the U.S. military in order to maintain a competitive advantage in warfare.

One of the driving forces behind transformation is the shift from the industrial age to the information age. The DoD publication *Military Transformation: A Strategic Approach*, states that "In the information age, power is increasingly derived from information sharing, information access, and speed. Thus, NCW is the military expression of the information age" (Military Transformation, 2003).

This same guidance reiterates the importance of several of the concepts of NCW: effects-based operations (EBOs), self-synchronization, and the shift away from platform-centric warfare (PCW). Figure 4 shows the new rules of information age warfare and Figure 5 shows how NCW lies at the very center of the convergence of the domains of twenty-first century warfighting.
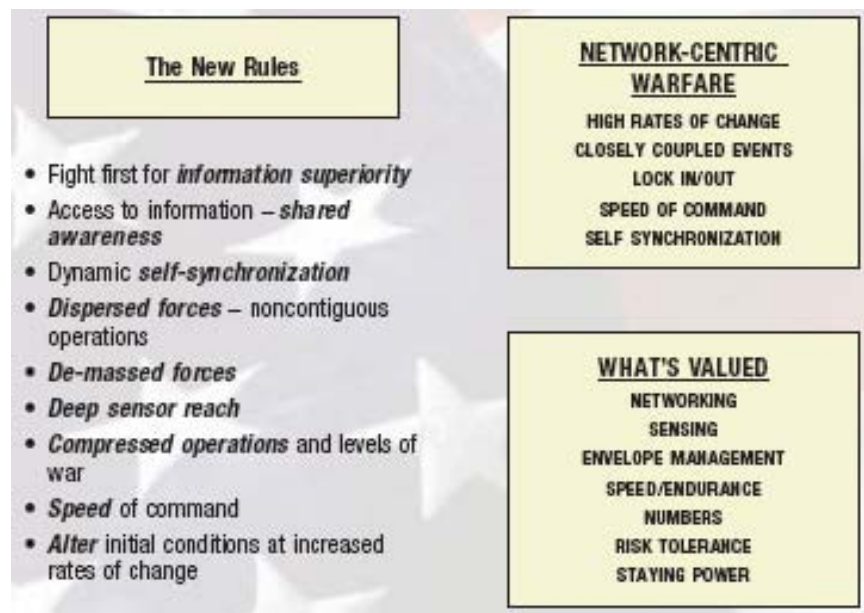

Figure 4 The New Rules of Information Age Warfare (Military Transformation, 2003).
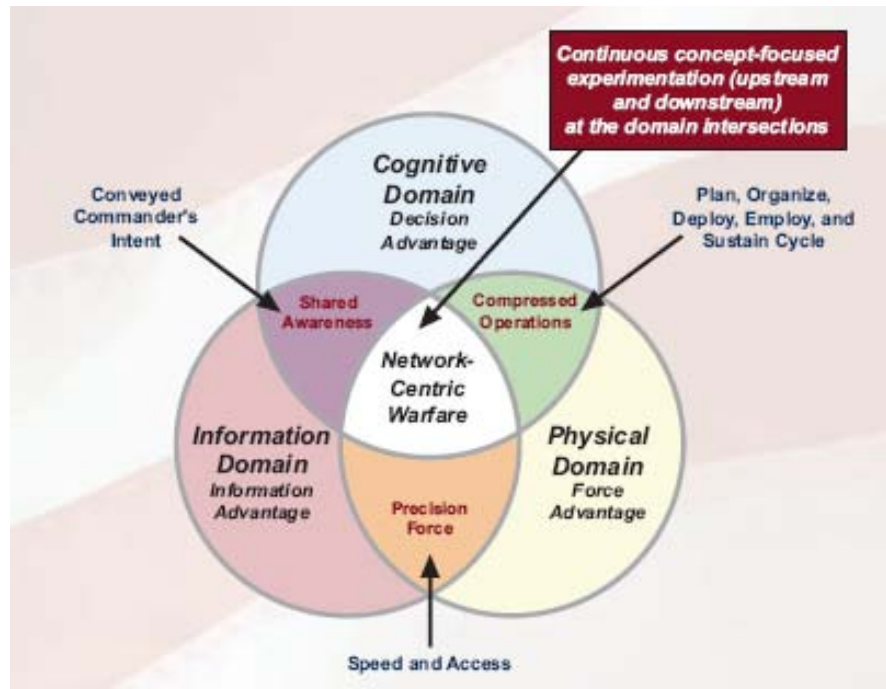
Figure 5 Information Age Warfare Domains of Conflict (Military Transformation, 2003).

Business Process Reengineering

Business Process Reengineering, or BPR, in its simplest sense is the art of dealing with organizational change. Although BPR has in some form been around for a very long time, it started to become a mainstream topic of study in the management theories that were developed in the latter half of the nineteenth century. In the 1880's, Frederick Taylor conducted studies regarding various forms of manual labor and business tasks. His findings from these studies concluded that managers could apply basic scientific and management principles to the task of redesigning work and "reengineering" it to optimize productivity (Weicher et. al., 1994).

In 1993, Michael Hammer and James Champy wrote a ground-breaking book, called *Reengineering the Corporation: A Manifesto for Business Revolution*, that

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redefined the concept of reengineering for modern times and coined the term "business process reengineering." In the book, Hammer and Champy do not claim to have invented BPR but they do take credit for "rediscovering it" (Hammer and Champy, 1993).

The formal modern definition of BPR is "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of performance, such as cost, quality, service, and speed" (Hammer and Champy, 1993). Within that definition are four key words that must be fully understood in context when examining BPR: fundamental, radical, dramatic, and process. The key word "fundamental" means a basic understanding of what a company is and what it really does. A company like Ford Motor may say their business is to sell cars, but on a fundamental level they may really be a company that provides a transportation solution to customers with a transportation need.

The term "radical" in this sense does not refer to something completely unorthodox or a total departure from the current way of doing something. Instead, it is complementary to the term "fundamental" in that it refers to getting to the root of a process in such a way that everything there is to know about that process in known. Hammer and Champy liken a radical change to one that is a reinvention vice a simple improvement. (Hammer and Champy, 1993)

"Dramatic" means looking for more than just incremental changes. A dramatic change brought about by the implementation of BPR should show an order of magnitude improvement, otherwise the change might not be worth the resources required to make it happen. Lastly, the key word "process" is the scope of the activities that are being examined for BPR opportunities. If you scope a process too broadly, you risk failure due

to over complexity. Conversely, if you scope a process too narrowly, you risk it not yielding the improvements that were sought.

In his 2001 follow-on work *The Agenda*, Hammer relates that in the 1990's, he thought the most important word in the BPR definition was "radical" and that understanding the implications of being radical was what made a successful BPR effort. Hammer relates that he has since reconsidered, based on extensive research and examination of case studies, and has concluded that the single most important thing to understand about BPR is the "process." Understanding what the process is becomes the key to determining how, or even if, to reengineer it.

There are three criteria which can be applied to determine whether or not a process is a good candidate for reengineering. They are listed as follows:

1. Dysfunction – used to define the degree to which a process is broken or to what degree it is ineffective. This can be brought about by factors such as neglect, incorrect focus, or over complexity.

2. Importance – used to define how critical a process is to the overall condition or success of a company or enterprise. More benefits can be gained by reengineering the most important processes first and saving those that aren't as important until later.

3. Feasibility – used to determine the likelihood that a particular reengineering effort will succeed. Usually, the larger the process, the lower the feasibility but the higher the payoff. The best processes to reengineer from this perspective are the largest ones that can be undertaken with an acceptable probability of success.

Information technology plays a big role in BPR concepts. Information technology can be a powerful tool for process redesign. However, it must be noted that automation and the use of information technology alone is not reengineering itself. Instead, it is a key enabler. Many times, efforts to automate an existing process just yield a broken process that it automated. Therefore, it is important to emphasize the role of information technology as a key part of the process, but not the process itself.

It is important to note that BPR is not an exact science. Not all BPR efforts achieve success. Some even revert back to the old way of performing the process. Also, it is possible that using evaluation criteria will lead to the incorrect decision to not reengineer a process. In spite of all this, BPR can reap huge benefits when undertaken. This section will close with an example of a very successful BPR undertaking as an illustration of the potential of BPR.

IBM credit had a credit approval process that took on average six days to complete. The credit application would go through a series of sequential steps, each managed by a different person. Management wanted to improve this process in order to make the whole process shorter, but did not have a definite plan on how to do so. The initial "solution" was to install an information-based technology solution that would provide detailed information on where an application was in the approval process. This solution improved visibility into the process, but did nothing to speed it up. Finally, two managers performed a "walk-through" of a single credit application and found that if they eliminated the time an application spent in an in-box, it only took 90 minutes to process! IBM then reengineered this process to have each application handled by a single "case

manager". This radical process redesign yielded huge results in time saved and improved

customer service. It also incorporates all four key words of the BPR definition:

fundamental, radical, dramatic, and process. (Hammer and Champy, 1993)

Summary

In an attempt to paint a complete picture, the literature review has attempted to

attack the issues from several angles. First, the value of information and technology has

been established as the foundation of the whole research problem. Next, the individual

issues of RMAs and NCW were discussed. The role of doctrine was next as well as the

level of support for NCW in Joint doctrine. Finally, the concept of BPR was introduced

and expanded. The methodology section will explain how all of these concepts will by

analyzed together.

III. Methodology

Purpose Statement

The purpose of this research paper is to determine if the concepts of Business Process Reengineering (BPR) provide a feasible framework for allowing the Department of Defense (DoD) to implement the concept of Network-Centric Warfare (NCW). NCW is the DoD's vision for a new way of warfare that allows the armed forces to transform from an industrial-age military to an information-age one.

Research Design

The research for this paper follows the basic premise of an investigative case study. This case study is qualitative in nature and is based on the extraction of relevant data from a variety of sources, to include journal and periodical articles, textbook material, prior academic theses, material from the Internet, and a grouping of specific military research resources such as reports, studies, and published doctrine. The case study methodology is appropriate for this research paper based on the definition provided by John W. Creswell in his research methods book, *Research Design*. Creswell defines the case study as the in-depth exploration of "a program, an event, an activity, a process, or one or more individuals" (Creswell, 2003). When combined as they are in this research paper, the concepts of NCW, RMAs, and BPR fall within the case study methodology definition.

By using the information derived from the analysis of the literature review, the investigative questions from Section I will be answered which will, in turn, provide the basis of the answer for the overall research problem as stated in Section I. These results

will further be expounded upon after the analysis, in a section that provides recommendations and conclusions regarding the discussions of the investigative questions and the research problem.

Research Method Validity

There are several valid methods for conducting research, of which the case study is but one. In his book *Case Study Research Design and Methods*, Robert K. Yin states that "In general, case studies are the preferred strategy when 'how' or 'why' questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context" (Yin, 2003). Adding a simple "How" to the beginning of the research problem identified in Section I satisfies this criteria without changing its meaning or context.

Another characteristic of the case study is that it is an appropriate method for conducting observations and drawing conclusions when the researcher has little or no ability to exert control over or manipulate any of the entities or phenomena being studied. Again, the applicability to this research paper is valid, as the author is making no attempt to influence or conduct experiments on the concepts of Network-Centric Warfare (NCW) or Business Process Reengineering (BPR). Rather, the intent is to assess the applicability of using BPR to facilitate NCW by conducting an examination of the existing body of knowledge and looking for correlations and historical examples that support this. (Yin, 2003)

When conducting the case study, Yin identifies six main sources of evidence: documentation, archival records, interviews, direct observations, participant observation,

and physical artifacts. Due to factors of variability and situation specifics, it should be noted that no single source holds a definite advantage over the others. It is also often the case that multiple sources will complement each other and provide a level of corroboration either supporting or rejecting the research proposal. (Yin, 2003)

This research paper relies on two sources of evidence: documentation and archival records. This is primarily due to the large volume of each of these sources that was readily available. The other four main sources were rejected due to their reliance on tangibility and time requirements. NCW is still in its infancy and will take several years to come to fruition, if it ever does. This makes direct and participant observation difficult, if not impossible. Also, since NCW is still more theoretical than real at this time, there is a definite dearth of physical artifacts to study.

The ultimate goal of utilizing the case study methodology is to gather comprehensive, unbiased evidence that either supports or refutes the research proposition. For this research paper, the author's goal is to establish that the body of evidence supports the proposition that BPR concepts are well-suited to serve as a framework for helping the DoD attain its goal of transitioning the U.S. military from a platform-centric force to a network-centric one. The following section is an analysis, based on the examination of the information obtained through the literature review, that provides an answer to the proposition stated above and the overall research problem of this paper.

IV. Analysis

The analysis section of this research paper begins by answering the individual investigative questions based on information derived from the literature review. After all of the investigative questions are answered, they will support an overall answer to the research question posed by this paper.

Investigative Question # 1

What is the potential impact of the network-centric warfare concept for the Department of Defense?

An analysis of this investigative question based on information in the literature review reveals that network-centric warfare (NCW) has the potential to be the biggest single change ever in the history of America's armed forces. NCW is a concept based on the power of information and information technology (IT). The literature review provided several historical examples supporting the position that information is a commodity of tremendous importance to military operations.

Historically, information has demonstrated itself to be a force enabler that provides a tremendous advantage to the military force that is best able to collect and exploit information. Indeed, as society in general migrates from the industrial age to the information age, the military is following suit and "transforming" itself from a fighting force that depends primarily on the superiority of mechanical technology to one that is equally dependent on IT for its effectiveness.

The arguments for embracing IT are compelling. Whereas the cost of mechanical technology generally becomes greater as capacity increases, information technology

generally follows the opposite trend. Each new generation of IT systems fielded have exponential increases in capability without a proportional increase in cost. Therefore, by leveraging IT, NCW has the potential to greatly increase the effectiveness of the armed forces while at the same time being able to do so with fewer resources, realizing a tremendous cost savings. For example, currently projecting the number and types of forces to field to a theater is somewhat determined by uncertainty as to exactly where and when they will be needed, thereby requiring planning based on worst-case scenarios and leading to fielding more than what is actually used (or needed). Leveraging the potential power of NCW would allow a better picture of the battlespace, showing planners exactly what assets are needed where. This would put only the required forces in the right place at the right time, eliminating overhead and massing effects rather than forces.

Investigative Question # 2

> **Does NCW currently meet the criteria for being a true revolution in**
>
> **military affairs?**

As discussed in the literature review, revolutions in military affairs, or RMAs, are basically fundamental changes or advances in technology, tactics, or doctrine that render contemporary ways of fighting war obsolete. The historical discourse of previous RMAs highlight this point as it seems quite clear in hindsight of the impact they had. The telegraph, the railroad, the internal combustion engine, and the nuclear bomb are some prominent examples of RMAs. In their own way, they each changed the face of warfare forever.

Using Hundley's criteria for identifying RMAs as listed literature review, it seems at this point that NCW meets all of them well enough to support the argument that NCW is a true RMA. Certainly NCW has the capability to render most current ways of warfare obsolete. Also, due to this factor, a military that rapidly adapts to NCW has the potential to challenge the core competencies of any adversary who is not as network-centric.

Certainly, there is a compelling argument that the "RMA Trinity" (doctrine, technology, and organizational adaptation) identified in the literature review has come to fruition for the U.S. military. The U.S. is second to none in terms of IT development and utilization. As seen in the descriptions of Joint Vision 2010 and Joint Vision 2020, doctrine supports the transition to an information-age military at the highest levels. In fact, IT is described as the cornerstone, or "key enabler" of the twenty-first century military. Organization adaptation has in some forms been present since the Gulf War and recently culminated with operations during Operation IRAQI FREEDOM. The combination of precision-guided munitions, integrated communications, and the synchronization of forces has arguably resulted in a capability that is greater than the sum of its parts and has provided an unequaled capability to U.S. forces.

Although all of the signs that indicate that NCW is a true RMA exist, there is still one caveat to consider. Historically, an RMA has to have come to fruition before it is identified as such. That does not seem to be the case with NCW. Even as it is being identified as a true RMA, research also indicates the consensus that it will be several years before we see the fruition of the NCW concept. Nevertheless, there is little reason to doubt, based on the existing body of knowledge, that there is no evidence at this point to discount NCW as a true RMA.

Investigative Question # 3

What does doctrine say about the concept of network-centric

warfare?

This question was briefly addressed when answering question 2, but it deserves

some additional discussion here. The fact that network-centric warfare is covered at the

joint level is telling. It signals a commitment at the highest levels of the Department of

Defense to embrace the concepts of NCW as the future warfighting capability of the

armed forces. Although, as stated in the literature review, that doctrine is not directive, it

is authoritative and provides the high-level "common picture" for all of the services to

base their strategy on.

Although not technically doctrine, the Network Centric Warfare Report to

Congress, also discussed in the literature review, fits in well with this section and helps

flesh out the answer to this investigative question. The volumes of data within this report

and the level to which its conclusions support the transition to a network-centric military

help to reaffirm the doctrine that supports NCW concepts. Also, although the focus of

this research paper is at the joint level, it is worth a quick mention to note the NCW

Report to Congress also concluded that the individual services are incorporating doctrine

at their own levels that place a huge emphasis on becoming network-centric. This is a

good thing and it is important because it would be difficult to incorporate this at the joint

level without individual service support. On the other hand, there is also a potential

pitfall associated with the individual services incorporating their own doctrine if it is not

based on joint doctrine and directed towards a common goal of incorporating NCW at the

DoD level. A situation that should be avoided at all costs is to let the services become network-centric individually. This flies in the face of the Joint concept and would fail to achieve the true potential of NCW, which calls for the incorporation of every node (whether it be a ship, plane, tank, squad, or individual soldier) into a single network in order to obtain complete battlespace awareness and achieve maximum force effectiveness and efficiency. Each service becoming network-centric individually would result in systems that were not necessarily interoperable and would amount to little more than the current state of platform-centricity that is highly automated by the use of Information Technology. As stated previously, individual service support is critical if NCW is live up to its potential, but the services must stay within the context of becoming network-centric at the DoD level.

Investigative Question # 4

> **What is business process reengineering and what determines if a process is suitable for business process reengineering concepts?**

Business Process Reengineering (BPR) is a fundamental redesign of processes in order to produce dramatic improvements in some type of measured criteria. Forms of BPR have been around since the nineteenth-century but it became more prominent as a topic of study in the late 1980s and early 1990s. Although, as the name suggests, BPR is primarily applied to business areas, in its simplest form, BPR deals with the overall concept of organizational change and as such has the potential to be applied over a wide range of disciplines. It must be noted that BPR is not an exact science and there is no tried and true blueprint for undertaking a BPR effort.

Technically, any process is a potential candidate for BPR. However, Hammer and Champy, two leading BPR advocates in recent years, have outlined some basic criteria to use as a guideline when evaluating a process for BPR. These criteria are: dysfunction, importance, and feasibility. The more dysfunctional a process is, the more it needs BPR. Also, the more important a process is, the higher a priority it should have when being evaluated. Last, feasibility is an important criterion for determining how successful a BPR undertaking can be. Hammer and Champy have also developed a checklist of steps for conducting BPR exercises, which will be discussed further in the analysis of the research problem.

Research Problem

Can the concepts of Business Process Reengineering be used to develop a framework for implementing the changes required to transform into a network-centric military?

The answers from the individual investigative questions should lead in a general direction that will provide an answer, one way or the other, to the general research problem. The review of the literature leads to some conclusions that answer the research problem. First, one conclusion is that NCW is a concept that has a lot of support in the DoD. It is apparent through doctrine, reports, studies, and the analysis of recent military operations that we are undergoing a fundamental change in the way we view warfare and the way the U.S. military intends to fight wars in the future. There is a transition occurring in the military from the industrial age to the information age. Concepts such as effects-based operations (EBO) and NCW are quickly replacing the old platform-centric

warfare (PCW) mentality. The DoD has taken a headfirst leap into this massive transition, also referred to as force transformation. Newly-fielded systems, doctrine, and new, innovative ways of conducting operations are all pointing towards a heavy reliance on information and IT for maintaining military capability.

The literature review also helps to identify the current state of the U.S. military in becoming network-centric. Its clear from this that many pieces of the puzzle are already in place. Technology has proven its capability and there is a lot of evidence that the technology to implement NCW is already in place or just over the horizon. Also, doctrine is highly supportive of NCW. The doctrine that advocates NCW as the key enabler of the future U.S. military is already in place. Additionally, analyses that indicate NCW is the next RMA are in abundance and are rarely disputed. All of these factors taken together present a strong argument that we are already on an unalterable course towards becoming a network-centric military.

Given all of this, what seems to be missing? The need for, importance of, and feasibility for becoming network-centric have been established for the DoD. The one piece that seems to be missing is an actual game plan for how to go from Point A to Point B. There is a general consensus that we need to implement NCW and that we will implement NCW, but there is no clear path on how we will do it.

BPR provides the framework to show how to go from Point A to Point B. Applying the BPR criteria to NCW yields the following:

1. Dysfunctionality – The more dysfunctional a process is, the better a candidate it is for BPR efforts. Although it is hard to argue that the world's preeminent military is dysfunctional, it might be on some levels. First, even without becoming

network-centric, the military is still caught up in the IT revolution. IT in and of itself is only a tool, not a complete solution. IT brings about rapid change and this is something the military is not geared for. This alone provides some level of dysfunctionality. Also, the military still mainly operates as four distinct services, each with their own areas of expertise and functional stovepipes. The transition into a more joint environment has provided some level of dysfunction as the services try to adapt. As much of the joint strategy is based on leveraging IT, this dysfunction becomes an area of concern for implementing NCW.

2. Importance – This topic does not need a lot of readdress. It suffices to say that NCW is very important to the DoD as evidenced by Joint doctrine and examples from recent military operations. Based on this, NCW passes the importance criterion for BPR.

3. Feasibility – This is the least well-established factor. Most BPR efforts focus on processes that occur at a level lower than that of the enterprise as a whole. NCW is a DoD-wide effort and there is little evidence of previous undertakings of this scale. Nevertheless, limited efforts to become network-centric have been promising and there is no compelling evidence to suggest that a DoD-wide effort would not be possible.

Based on this analysis, it is possible to answer the research problem positively, in that the body of research conducted confirms that the concept of NCW is such that the concepts of BPR provide a viable framework for transitioning to a network-centric military. This analysis therefore accepts the null hypothesis from the methodology section and rejects the alternate hypothesis.

V. Recommendations/Conclusions

Recommendations

Based on reaffirming the research problem, that is, that Business Process Reengineering (BPR) provides a viable framework for evolving the military towards Network-Centric Warfare (NCW), there are three critical recommendations to be made.

First, when undertaking an effort such as this, it is extremely important to remember the role of information technology (IT). IT is not the ultimate goal, it is only a key enabler. The main focus should always revolve around the process. The military needs to constantly stay aware of this and avoid attempts to automate things just for the sake of automation. As stated before, automating a messy process only yields an automated mess. The Department of Defense always needs to maintain a focus on what it wants to accomplish and only after that is determined look for ways to allow IT to get it there.

Second, the DoD needs to consolidate the leadership positions responsible for transforming into a network centric military. Currently, the DoD focal point for BPR efforts resides in the office of the Assistant Secretary of Defense for Command, Control, Communications, and Information while the DoD focal point for NWC is the Office of Force Transformation, which also reports directly to the Secretary of Defense. Given the common goals and potential overlap of these two offices, there is a compelling argument to consolidate the DoD's BPR and NCW efforts under a single office. This single office should most likely be the Office of Force Transformation.

Third, and last, the DoD should set a dates for achieving certain network-centric milestones. Currently, this is lacking and to some degree might be a detriment to motivation. This recommendation was also echoed in the NCW Report to Congress as a key step for beginning NCW transformation efforts.

Conclusion

It is quite clear that the DoD is on the verge of its most significant change in its history. The transformation from a fighting force that relied on the technology of its weaponry to one that is equally reliant on information and the power of IT is profound. It promises to revolutionize the way that U.S. forces will conduct combat operations and will facilitate an unparalleled level of joint operations. NCW is a force enabler and a force multiplier all in one. It has the potential to increase combat effectiveness by orders of magnitude without a corresponding increase in personnel or cost.

Becoming network centric may be a long process and it is clear we are only in the early stages. As such, not all of the pieces are in place. Technology and doctrine are well advanced, but the biggest unknown at this point is how to develop an actual migration plan. This paper proposes that BPR concepts are a good match for incorporating NCW. Looking at the NCW problem in terms of a BPR project provides an excellent opportunity for developing a viable, effective gameplan for bringing out armed forces smoothly into the twenty-first century.

Suggestions for Further Study

This paper examines the concept of NCW from a point of view that is strictly internal to the DoD. Given that the recent conflicts the U.S. has been involved in indicate

a trend towards combined and coalition operations, there is a lot of potential for further study in these areas. All of the concepts touched upon in this paper, to include the use of IT, interoperability, and doctrine, have applicability when discussing NCW at the combined and coalition levels. There is also a political dimension that arises at this level with many legal and technical implications. Once the DoD establishes a NCW capability for U.S. fighting forces, the next logical step is to extend the capability to our partners and allies. The lessons learned from current efforts can be combined with further study to make future efforts as successful as possible.

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Glossary

CALCM   Conventional Air-Launched Cruise Missile

CONOPS   Concept of Operations

DoD   Department of Defense

EBO   Effects-Based Operations

GIG   Global Information Grid

GPS   Global Positioning System

ICBM   Inter-Continental Ballistic Missile

IT   Information Technology

JSTARS   Joint Surveillance and Target Attack Radar System

JV 2010   Joint Vision 2010

JV 2020   Joint Vision 2020

NCW   Network-Centric Warfare

PCW   Platform-Centric Warfare

RMA   Revolution in Military Affairs

SOS   System of Systems

TLAM   Tomahawk Land-Attack Munition (Cruise Missile)

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14. ABSTRACT
Network Centric Warfare (NCW) is the concept that will allow the military to transform from an Industrial Age force to an Information Age one. NCW strives to use Information Technology (IT) to make military forces more effective while reducing the overall footprint of a force. Capitalizing on the power of networks in this way realizes the goal of being able to do more with less.

The Department of Defense (DoD) has placed a lot of emphasis on NCW as the future way of fighting for U.S. armed forces. DoD doctrine, including the *Joint Vision* series of documents, identifies Information Superiority as the key enabler of the future fighting force. Likewise, the individual services have also begun to take a look at how IT can be used as force enablers in order to enhance warfighting capability.

The research reveals that although great emphasis has been placed on the need to become network-centric, there is no solidified gameplan on how to implement it. The concept of Business Process Reengineering (BPR) was considered as a possible template for instituting NCW and was found to be a good fit. BPR is geared towards *radical*, *fundamental* changes, terms which can easily be applied to NCW. The research concludes with some specific recommendations for using BPR principles to facilitate the DoD's transformation towards NCW.

15. SUBJECT TERMS
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